


Usefulness of IPC ECHO Clinic in Tanzania— Experience from Its Evaluation in 10 Referral Hospitals

Ruth R. Ngowi^{1*}, Stephano S. Simba², Joseph C. Hokororo¹, Doris Lutkam²,
Erick S. Kinyenje¹, Chrisogone J. German¹, Radenta P. Bahegwa¹, Yohanes S. Msigwa¹,
Omary A. Nassoro¹, Laura E. Marandu¹, Mwajabu H. Machibya¹, Syabo M. Mwaisengela¹,
Mbwana M. Degeh¹, Talhiya A. Yahya², Daud Peter³, Jacob Lusekelo⁴, Edgar Lusaya²,
Eliudi S. Eliakimu¹

¹Health Quality Assurance Unit, Ministry of Health, Dodoma, Tanzania

²Management Science for Health, The Medicines Technologies and Pharmaceuticals Services (MTaPS) Program, Dar es Salaam, Tanzania

³Directorate of Research, Training and Consultancy, Kibong'oto Infectious Disease Hospital, Kilimanjaro, Tanzania

⁴Diagnostic and Healthcare Technical Services Unit, Ministry of Health, Dodoma, Tanzania

Email: *rngowi2016@gmail.com

How to cite this paper: Ngowi, R.R., Simba, S.S., Hokororo, J.C., Lutkam, D., Kinyenje, E.S., German, C.J., Bahegwa, R.P., Msigwa, Y.S., Nassoro, O.A., Marandu, L.E., Machibya, M.H., Mwaisengela, S.M., Degeh, M.M., Yahya, T.A., Peter, D., Lusekelo, J., Lusaya, E. and Eliakimu, E.S. (2025) Usefulness of IPC ECHO Clinic in Tanzania—Experience from Its Evaluation in 10 Referral Hospitals. *Health*, 17, 1299-1318.

<https://doi.org/10.4236/health.2025.1710086>

Received: July 23, 2025

Accepted: October 24, 2025

Published: October 27, 2025

Copyright © 2025 by author(s) and Scientific Research Publishing Inc. This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

Background: Tanzania adopted the Project ECHO platform in 2016 to build healthcare workers' capacity in HIV rapid testing services. As of June 2025, 13 ECHO clinics are running, including a monthly Infection Prevention and Control (IPC) clinic launched in 2022. This study highlights the clinic's usefulness and provides recommendations for future focus areas. **Objective:** To assess the usefulness of the IPC Project ECHO clinic to users in Tanzania, and to explore topics/areas that need to be included in the upcoming curriculum for the IPC ECHO Clinic. **Methods:** An explanatory study design using a qualitative method of data collection was used to collect data from all 10 facilities supported by the Medicines, Technologies and Pharmaceutical Services (MTaPS). This study presents results on the objective of assessing the usefulness of the IPC Project ECHO clinic in Tanzania. **Results:** Analysis has shown that the IPC ECHO clinic was useful to healthcare workers in different areas such as how to conduct environmental surveillance, monitoring of surgical site infections (SSIs), integration of IPC and antimicrobial stewardship activities, and networking. Furthermore, healthcare workers suggested areas/topics that need to be included in the upcoming curriculum for the IPC ECHO Clinic. These areas include surveillance of healthcare-associated infections (HCAIs), antimicrobial resistance, decontamination, waste management, IPC

data analysis and use, hand hygiene, logistics for IPC supplies and equipment, guidance on the use of Personal Protective Equipment (PPE) at health facilities, prevention of HCAs at dialysis units, patients with heart and cancer diseases, and how to monitor the quality of water. **Conclusion:** The IPC ECHO Clinic proved beneficial to healthcare workers by enhancing their knowledge and skills in key IPC areas. Participants also recommended expanding the curriculum to cover crucial topics such as HCAI surveillance, antimicrobial resistance, PPE use, and IPC in specialized care settings.

Keywords

Infection Prevention and Control, Project ECHO, Evaluation, Tanzania, Quality Improvement Focal Person (QIFP), Infection Prevention and Control Focal Person (IPCFP)

1. Introduction

Healthcare-associated infections (HCAIs) occur as a result of non-compliance with infection prevention and control (IPC) standards [1]. It is estimated that one in four of all hospital-treated sepsis cases are HCAIs [2]. HCAIs have a significant burden on healthcare systems in general, including increased length of stay during healthcare delivery and increased costs of services [2]. Improvement in the implementation of IPC programs is key to reducing the impact of these infections and the spread of multi-resistant microorganisms. Furthermore, prevention and management of HCAIs require collaboration among all healthcare workers with shared knowledge of best practices [3].

Following the recommendations from the WHO, as well as the presence of emerging and reemerging diseases, Tanzania revised the National IPC Guidelines in 2018 and developed standard operating procedures (SOPs) to guide healthcare workers on IPC practices for Coronavirus disease 2019 (COVID-19) and Ebola Virus Disease [4] [5]. Despite the developed guidelines and SOPs, several other interventions have been implemented in Tanzania so as to improve the quality of services; as well as, to reduce the risk of HCAIs. These interventions include: dissemination of developed IPC guidelines and SOPs; distribution of supplies to support implementation of IPC practices; improvement of infrastructure; supportive supervision; mentorship of healthcare workers on IPC practices; as well as the training of healthcare workers [6].

Following COVID-19, health services were disrupted in low- and middle-income countries (LMICs), which necessitated countries to take various measures to ensure continuity of services, including the use of various digital platforms in training [7]-[10]. During this pandemic, several stakeholders in Tanzania assumed different responsibilities for global health security and safety; this includes COVID-19 training for healthcare workers through an e-learning platform supported by the MTaPS Project [11]. Healthcare workers received training by ac-

cessing IPC sessions available at the Center for Distance Education, and training was also provided to healthcare workers using Project ECHO™ (Extension for Community Healthcare Outcome) Platform. Project ECHO is a virtual platform designed to build capacity and share knowledge by connecting experts with practitioners through virtual case-based learning. Healthcare workers from health facilities shared their experiences on IPC practices as well as received training sessions from IPC subject matter experts from both public and private institutions. Project ECHO implementation uses a “*hub-and-spoke model*”, where the hub represents a facility with a team of subject matter experts who train, guide, and provide mentorship to others, while spokes represent facilities with healthcare workers who connect virtually with the hub during training sessions. As of June 2025, Tanzania has 18 operating hubs and 458 spokes. Despite the available spokes, individual healthcare workers may also join sessions through personal devices such as mobile phones, tablets, laptops, etc.

This study presents evaluation results on two objectives: assessing the usefulness of the IPC Project ECHO clinic to users in Tanzania, and exploring topics/areas that need to be included in the upcoming curriculum for the IPC ECHO Clinic. Results on other objectives of the evaluation have been presented elsewhere [12]. Healthcare workers provided their opinions on how they benefited from IPC trainings conducted through the Project ECHO Platform and provided their recommendations on IPC topics/sessions that need to be included in the upcoming trainings.

2. Literature Review

IPC is a key component of safe healthcare delivery, as it helps prevent the spread of diseases during routine services and outbreak periods. It also facilitates the continuity of essential services at health facilities. Dedicated and well-trained professionals play a crucial role in reducing HCAs in healthcare facilities and preventing antimicrobial resistance (AMR) through effective implementation of IPC best practices [13] [14].

Furthermore, adequate training of healthcare workers is key to ensuring that healthcare services are delivered at the highest possible quality and to minimizing the possibility of HCAs [15]. Practicing safer IPC activities is important in preventing and controlling the spread of HCAs, including highly infectious diseases in a healthcare setting [6] [16]. To strengthen health workers' IPC knowledge, capacity to implement IPC interventions, as well as to prevent and prepare for future health emergencies, including future pandemics, several online IPC courses have been established and implemented worldwide [17]-[20]. Some of these online trainings adopted the Project ECHO platform in delivering IPC knowledge to healthcare workers [21] [22].

Few studies have been conducted to evaluate the usefulness of IPC online trainings. The IPC Global Webinar Series among the IPC community conducted using the Project ECHO platform revealed that the use of adapted virtual communities

of practice and other learning networks for the IPC community can serve as a useful tool for addressing COVID-19 and other infectious disease threats [21]. Furthermore, the webinar was useful as it enhanced the increase of knowledge among participants in the world, particularly for those from LMICs [21].

Online training of COVID-19 on IPC for health care workers in psychiatric institutes in Japan revealed that the online training had improved knowledge, confidence, and attitude among health care workers [19].

Despite the usefulness of IPC online training, several studies have also indicated that more work needs to be done to build healthcare workers' knowledge. An evaluation study of online training for healthcare workers in Nigeria revealed that there are foundational IPC knowledge gaps; hence, a need for additional assessments and training among healthcare workers [23]. A study conducted in China to explore a more effective method of IPC training revealed that disinfection and sterilization are important cornerstones of IPC, and infectious disease management is a key area of concern for medical staff; hence, it needs to be the target area during training [24].

The WHO recommends monitoring and evaluation to check the effectiveness of IPC training and education conducted for healthcare workers [13]. The majority of the studies were conducted to evaluate the effectiveness of physical/in-class IPC training; however, there are few studies conducted to evaluate the usefulness of online IPC training through the Project ECHO platform. Hence, this study was conducted to fill this gap as well as to elicit areas/topics that need to be included in the upcoming curriculum for the IPC ECHO Clinic. Healthcare workers' opinions and feedback regarding training programs are important so as to improve the development and delivery of IPC training [25].

3. Methodology

3.1. Study Design

This study employed an explanatory study design using a qualitative approach. The evaluation was conducted to assess the usefulness of the IPC Project ECHO clinic among healthcare workers and to identify priority areas for future curriculum development.

3.2. Study Setting and Participants

The study was conducted in ten referral hospitals in Tanzania. These were the only hospitals supported by the MTaPS project in implementing IPC and Antimicrobial Stewardship (AMS) activities. The IPC ECHO clinic was initially implemented in these hospitals. Participants were purposively selected based on their official roles in quality improvement and infection prevention and control. Included participants were Quality Improvement Focal Persons (QIFPs), Infection Prevention and Control Focal Persons (IPCFCPs), members of Quality Improvement Teams (QITs), and heads of Work Improvement Teams (WITs). QIFP and IPCFP are designated individuals appointed to lead quality initiatives and IPC in-

terventions, respectively. Also, QITs and WITs are responsible for overseeing quality improvement initiatives and fostering a culture of quality both at the facility-wide level and within individual departments.

3.3. Sampling Strategy

A purposive sampling technique was used to recruit participants with firsthand experience in IPC ECHO implementation. The sample included sixteen participants for in-depth interviews and thirty-seven participants across three focus group discussions. The selection aimed to ensure representation from all ten hospitals and to capture diverse perspectives across professional roles.

3.4. Data Collection Tools and Procedures

Data were collected through virtual in-depth interviews and focus group discussions using structured guides. Sixteen in-depth interviews were conducted with QIFPs and IPCFPs, while three focus group discussions involved QIT members and heads of WITs. The qualitative tools, such as an in-depth interview guide (for individual interviews) and a focus group discussion guide, were designed and used to explore participants' experiences, perceived usefulness of the IPC ECHO clinic, and recommendations for future sessions.

3.5. Data Management and Analysis

Qualitative data were transcribed within 24 hours of collection to minimize recall bias, then translated into English and analyzed thematically using a deductive coding framework. Themes were organized into supra-codes, main codes, and sub-categories. To enhance trustworthiness, direct participant quotes were included to support the interpretation of findings and reflect the depth of participant perspectives [26]. Results of evaluation of IPC ECHO in terms of “*enablers and barriers, and eliciting recommendations for further improvement and scale-up*” have been published elsewhere [12]. Therefore, this paper presents findings on the usefulness of IPC ECHO clinic among healthcare workers and recommended topics/areas that need to be included in the next IPC Project ECHO trainings.

4. Results

4.1. Profile of the Study Participants

A total of sixteen (16) healthcare workers participated in key in-depth interviews, all of whom were from the quality improvement units or departments of their respective health facilities. Among the participants of the virtual in-depth interviews ($n = 16$), 12 (75%) were women and 4 (25%) were men, with the majority of them being Nurse Officers 10 (62.5%). Other healthcare worker cadres included: Environmental Health Officer, Assistant Nurse Officer, Clinical Pharmacist, Medical Officer, Radiologist, and Nurse Midwife. Among the 16 interviewed healthcare workers, 10 were Quality Improvement Focal Persons and 6 were Infection Prevention and Control Focal Persons. Quality Improvement Focal Person

(QIFP) is an individual appointed to lead and coordinate all efforts focused on improving the quality of services at the facility. Infection Prevention and Control Focal Person (IPCFFP) is the appointed individual among the quality improvement team who oversees, leads, and coordinates all IPC interventions at the facility.

In the three focus group discussions (FGDs) conducted, 37 participants were involved; among them, 25 were females and 12 were males. The majority of the participants were nurse officers, 14 (37.8%). Gender and the department of the participants involved in FGD are as shown in **Table 1** below:

Table 1. Cadre and department of the participants who were involved in the focus group discussion.

Characteristics	Participants of the virtual FGD (n = 37)
A: Gender	
Nurse Officers	14
Assistant Nurse Officers	5
Medical Officers	5
Surgeons	3
Medical Attendants	3
Pharmacists	3
Information and Communication Technology Officers	2
Obstetrics and Gynecology Specialist	1
Environmental Health Officer	1
B: Department	
Quality Improvement Department/Unit	17
Wards (Obstetrics and Gynecology, Surgical, Medical)	11
Administration	3
Emergency Department	2
Main Pharmacy Store	1
Operating Theater	1
Orthopedic Clinic	1
Outpatient Department	1

4.2. Usefulness of the IPC ECHO Clinic to Users in 10 Referral Hospitals

The analysis of the findings on healthcare workers' perceptions of the IPC ECHO Clinic was grouped into four themes to explain the usefulness of the IPC ECHO Clinic at the health facilities. These four themes include: environmental surveillance; monitoring of surgical site infections (SSIs); integration of IPC and antimicrobial stewardship (AMS) activities; and networking.

4.2.1. Environmental Surveillance

Participants indicated that through the IPC ECHO clinic, they received knowledge on how to conduct environmental surveillance to monitor IPC practices that are implemented within healthcare settings. It was reported that “*IPC ECHO session helped us to get evidence-based updates, for example, through the sessions we managed to understand how environmental surveillance is done, results, and which areas to focus more during cleaning...*” (FGD Number 1).

It was also emphasized that “*IPC ECHO learning capacitated us on decontamination of instruments, the use of personal protective equipment, and the importance of environmental culture and sensitivity in order to reduce the burden of AMR*” (FGD Number 2).

4.2.2. Monitoring of Surgical Site Infections

Participants noted that the IPC ECHO clinic helped them improve their practices in monitoring SSIs and reduce the number of SSIs at their health facilities:

“*ECHO session helped us to improve infection prevention and control surveillance data collection by appointing a ward or department focal person that collects data and submits it to the quality assurance team. These practices hasten, increase the number and quality of data collected, ultimately contributing to reducing surgical site infections at our hospital*” (FGD Number 1).

Another healthcare worker during group discussion reported that: “*We benefit from the topic of how to monitor SSIs in the health facility*” (FGD Number 1).

4.2.3. Integration of IPC and Antimicrobial Stewardship (AMS) Activities

Healthcare workers reported that IPC ECHO sessions were useful in their health facilities as they were able to strengthen the AMS committee and integrate the coordination of IPC and AMS interventions in combating the burden of antimicrobial resistance.

“*We benefited from the IPC ECHO session, whereas currently the AMS committee is well strengthened. The AMS committee is currently working closely with the quality improvement team, where IPC activities are coordinated*” (FGD Number 2).

“*We benefited from the session on antimicrobial resistance..... as the hospital we were not doing well on AMS interventions. After the sessions, we have already started to conduct our own research on antimicrobial resistance and antimicrobial stewardship*” (FGD Number 3).

4.2.4. Networking

Healthcare workers highlighted that ECHO sessions were useful for them, as it helped them to collaborate among themselves within the health facilities, between health facilities, as well as between health facilities and IPC subject matter experts and facilitators.

“*Experience from other hospitals helped us to change our ways, also, we have increased networking among us, whereas in case of any challenge we may contact other hospitals and subject matter experts*” (FGD Number 1).

“ECHO improved our networking and cross-learning from other hospitals and increased the quality of our services” (FGD Number 1).

“...through ECHO sessions we were able to build capacity among ourselves; we receive experience from other health facilities and network with other health facilities” (FGD Number 2).

4.3. Topics/Areas that Need to Be Included in the Upcoming Curriculum for the IPC ECHO Clinic

Interviewed ECHO clinic coordinators and healthcare workers who participated in the focus group discussion, including Quality Improvement Focal Persons (QIFPs) and Infection Prevention and Control Focal Persons (IPCFCPs), provided areas that need to be included in the upcoming curriculum for the IPC ECHO Clinic. These areas were: surveillance of HCAs; antimicrobial resistance; decontamination; waste management; IPC data analysis and use; hand hygiene; logistics for IPC supplies and equipment; guidance on the use of personal protective equipment (PPE) at the health facilities; prevention of HCAs at dialysis units, patients with heart and cancer diseases, and how to monitor the quality of water.

4.3.1. Surveillance of Healthcare-Associated Infections (HCAs)

Participants felt that sessions on HCAI surveillance should be emphasized in the upcoming curriculum, as HCAs are still a burden in their healthcare settings:

“If possible, we should repeat sessions on Catheter and Ventilator Associated Infections because in our healthcare setting, we think that these are the areas with more challenges and we have started monitoring and prevention interventions, but we have not yet reached the required quality standards” (FGD Number 1).

“... We should continue with the sessions on Catheter-Associated Urinary Tract Infection, as for the previous session we benefited from this session. This will help us in the prevention of this infection at our health facilities,” emphasized QIFP (KII Number 5a, QIFP).

It was narrated that more guidance is needed on how to monitor and prevent HCAs: *“We may concentrate more on HCAs so that people may get more education on HCAs prevention” (KII Number 1a).* Another key informant added that *“HCAs should be emphasized in the next curriculum because it is still a challenge, and we need to hear from our fellow health facilities how they monitor and combat HCAs” (KII Number 1c, IPC FP).*

Coordinator of the IPC ECHO clinic stated that *“... we need to do more sessions on HCAI surveillance in our healthcare settings, as we may have areas colonized and we are not aware of these areas, and maybe we have not taken data extensively to realize which areas are colonized with which microorganism” (KII Number 4a, QIFP).*

It was also reported that neonatal sepsis is among the challenges and causes of referrals; hence, participants advised including the session in the next curriculum so that they can understand how to prevent it: *“We should continue to discuss neonatal sepsis, as on our side this is still a challenge. We receive a significant*

number of referrals from other health facilities regarding neonatal sepsis, and I can see the number of neonatal sepsis cases has increased, so we may include this session as part of HCAs surveillance so that we can see if other hospitals experience the same challenge and how to deal with it" (KII Number 5c, IPCFP).

Regarding surveillance of HCAs, other participants noted that: *"we should continue to emphasize issues on surgical site infection as it is still a challenge to both healthcare workers and clients"* (KII Number 8a, QIFP).

"Surgical site infection should be included in the next session because we have a number of SSI, especially for those who underwent caesarean section. We should discuss more so that we may know what are the possible causes of this problem..." (KII Number 8c, IPCFP).

"..topic on monitoring of hospital-acquired infections should be emphasized so that we may have mutual understanding ... for example,.. especially on timing as to when to start follow-up of clients to monitor other types of HCAs such as Catheter-Associated Urinary Tract Infection and Ventilator-Associated Pneumonia, currently, monitoring of SSI is not a challenge at our health facility..." (KII Number 10a, QIFP).

4.3.2. Antimicrobial Resistance (AMR)

Participants emphasized the need to include AMR in the upcoming session, noting it remains a challenge in service provision. *"...important topics that we need to have included in the next session are... AMR sessions, as we are taking care of patients but maybe there is something wrong with our calculation of medicines prescribed, we need more clarification and knowledge regarding antimicrobial resistance"* (KII Number 3c, IPCFP). IPC FP emphasized that *"another topic is antimicrobial resistance, as I see it is an area that has challenges, we should continue with this session and not leave it so that all health facilities could be able to get more knowledge on this area"* (KII Number 5c IPC FP).

It was also highlighted that the session on AMR should also include interventions to be covered at the community level *"... we need to emphasize antimicrobial resistance as it does not end at the health facilities alone, we need to go until the community level... for example, we prescribe medicines to the client but when they feel good, they do not use medicines anymore, so we need to have sessions to focus more on community interventions"* (KII Number 1c, IPC FP). Emphasizing the need to have an AMR session and make more efforts to combat AMR, KII 6c, QIFP stated *"...I have more interest in AMR, it is a burden at the national level but it seems it has not been given that much effort... we have many challenges in antimicrobial use, we have a hospital formulary but we do not have enough data to support this, sometimes we use antibiotics that are resistant, hence the AMR session should be given priority"*.

In addition to AMR, the IPC ECHO coordinator emphasized the need to have a session on antibiotic use *"...another area should be on antibiotic use. We need to do more sessions on this, as we may be able to get guidelines for managing SSIs, guidelines for intraoperative and postoperative surgical site prophylaxis. If we*

have more sessions on antibiotic use, we will get data on what type of antibiotics our fellows use and to what extent they were useful to reduce chances of SSI” (KII Number 4a, QIFP).

4.3.3. Decontamination

Most of the interviewed IPC ECHO coordinators highlighted that the implementation of the decontamination process is still a challenge in their healthcare settings; hence, they recommended decontamination to be a topic of emphasis in the next IPC ECHO curriculum. “*We need to insist more on decontamination, as this area still has challenges in our settings... we need to hear what other hospitals are doing in decontamination and their achievements so that at the end of the day we can evaluate ourselves on the area of decontamination; this will help us to improve more from where we are,*” (FGD Number 3). It was emphasized that “*sterilization of equipment should be emphasized as we still have challenges in our healthcare settings,*” (FGD Number 1).

Among healthcare workers who participated in the FGD was a surgeon who emphasized that “*...as a surgeon, I think sterilization should be given priority in the coming sessions as I can see there is a challenge in the whole process of sterilization*” (FGD Number 2).

It was stressed that preparing chlorine solution for decontamination remains a challenge among health facilities, as they receive chlorine in varying forms and concentrations. “*The use of chlorine should be emphasized repeatedly... I can see we still have challenges in the preparation of chlorine solution despite having a formula for preparation; sometimes each department receives chlorine in different forms such as liquid, tablets, and powder form, and healthcare workers face challenges in using the available formula in preparing the solution. I request that this session should be repeated as we still have gaps, especially in the preparation and use.....*” (KII Number 5a, QIFP). Another coordinator of IPC ECHO clinic emphasized that “*...another topic to be included should be the preparation of chlorine for decontamination. We receive different types and strengths of chlorine, we managed to train our people, but there is still a challenge during preparation. We need more sessions as new types and strengths are distributed to health facilities*” (KII Number 3a, QIFP).

One healthcare worker expressed worry about the quality of disinfectants and antiseptics used; hence, highlighted the need to have more sessions on decontamination “*...another topic we should focus on is instrument processing and decontamination in general. It is an area where its implementation is not done effectively. Maybe we are using disinfectants and antiseptics that already have resistance, sometimes we may under-dilute or over-dilute the solution, hence we are not sure if these solutions are working properly. ... We also distribute a small amount of chlorine due to economic challenges*” (KII Number 6c, QIFP).

4.3.4. Waste Management

Healthcare workers pointed out that waste management is still a challenge in their

health facilities, and more sessions should be included in the upcoming curriculum to help healthcare workers have strategies to minimize mixing of waste and manage waste in general. “...waste segregation should be a topic that is frequently repeated since waste management is still a major challenge at our health facilities; this will help to remind healthcare workers in this area” (KII Number 3a, QIFP). Another key informant pointed out that “another topic to be included in the next sessions is on the strategies to eliminate all issues of waste mixing...waste mixing is still a challenge, we may not mix waste at the generation point, but there are challenges of mixing waste at the final disposal area...” (KII Number 5a, QIFP). “...another topic is waste segregation... it is still a challenge at our health facilities... especially clinicians do not understand issues on waste management, ...but I think waste segregation is a challenge in most health facilities...” KII Number 8a, QIFP emphasized.

4.3.5. IPC Data Analysis and Use

Healthcare workers reported the need to have a session on IPC data analysis and use, where research, audit, and monitoring results based on IPC will be shared, how to use IPC data for improvement, as well as emphasizing healthcare workers to do more research and studies on IPC.

“Include a session of presenting research results based on IPC implementation from our own health facilities, as we will get data and experience from our local operational research. This will motivate more health facilities to conduct operational research, and we will get references from setups in the same environment, because sometimes we find references for implementation but the available data does not reflect our settings...” (FGD Number 1). It was emphasized that “we should have a session on data analysis of IPC data collected from health facilities so that we can have data that is meaningful and can help us in the preparation of action plans for IPC.....” (FGD Number 1).

“We should have a session to encourage staff to do auditing in areas of interest, so that we not only collect IPC data but also make use of data collected...” (KII Number 9a, QIFP).

“We still need to place more emphasis on monitoring the IPC practices implemented and the use of IPC data at the health facilities” (KII Number 7b, IPC FP).

“We request that we may get results and data of SSIs surveillance from other health facilities so that we can compare ourselves with other health facilities. This will help us to evaluate ourselves and improve more” (KII Number 8a, QIFP).

4.3.6. Hand Hygiene

Interviewed healthcare workers underlined the need to continue having sessions on hand hygiene, as it helps to combat several diseases as well as reduce the risk of HCAs in general.

“...during COVID-19, the hand hygiene session was emphasized a lot. We need to hear more on this, as it helped us to combat other diseases such as diarrhea. For me, if this topic is taken and emphasized, we will be able to reduce a lot of

healthcare-associated infections” (KII, Number 1c). “Hand washing is still a challenge. We do wash our hands periodically, but it reaches a point where people do not wash their hands as per guidelines,” emphasized QIFP (KII Number 2a, QIFP).

“I think we should place more emphasis on hand washing, as it is the major area that will help us reduce contamination in our health facilities. If we improve in this area, we will be able to reduce infection in general” (KII Number 4a, QIFP).

4.3.7. Logistics for IPC Supplies and Equipment

It was reported that there are challenges in accessing supplies and equipment that are helpful in the implementation of IPC interventions. Hence, it was recommended to have a session where healthcare workers can get information about vendors for these supplies, as well as provide feedback on the quality of supplies distributed.

“I recommend that in these IPC ECHO sessions, we should have a session where our neighboring health facilities can share information on where they procure supplies and equipment that support IPC implementation in case they are missing from the Medical Store Department (MSD). We may also share who the stakeholders of IPC supplies and equipment in Tanzania are” (KII Number 5a, QIFP).

Another responder added that “I would like it if we could do a follow-up and have a session to provide feedback on the quality of IPC materials such as chlorine solution, safety box, and Mackintosh distributed by the Medical Store Department to the health facilities” (FGD Number 1).

4.3.8. Guiding on the Use of Personal Protective Equipment (PPE) at Health Facilities

It was reported that there are challenges in how PPE is used at the health facilities; hence, they called upon the IPC ECHO sessions coordinators to consider the need to have a session on PPE use.

“...mmmh, another topic is the use of PPE such as scrub suits and coats. For example, you can find a person wearing a scrub suit or coat in the wrong place, and then when you tell them, their answers reflect that they do not know the places where they are allowed to wear scrub suits and their coats... also, we need more guidance from the Ministry of Health, especially on the use of scrub suits. Is it a uniform nowadays??” (KII Number 9c, IPC FP).

4.3.9. Prevention of HAIs at the Dialysis Unit, Patients with Heart and Cancer Diseases

Healthcare workers who participated in the FGD highlighted that new specialty services are introduced at their health facilities; hence, they noted the need to have a session on how to prevent infection during the provision of these services.

“Currently, specialties have increased in our referral hospitals. We would like to get more IPC experience on dialysis and oncology services, and how patients and staff can be prevented from infections as far as dialysis and oncology services

are concerned, aaaah... we have a national cardiac institute, we also wish to get experience from them on how to prevent infections in patients with heart diseases” (FGD Number 3).

4.3.10. How to Monitor the Quality of Water

Healthcare workers noted a current gap in capacity for monitoring water quality and recommended that this topic be included in the upcoming curriculum.

“...another area to be considered is water hygiene and sanitation, as most health facilities are currently using wells as a source of water, but they are not considering the quality of water, such as treatment of well water. Hence, we are not sure about the safety of water used; therefore, this area should be considered in the next sessions so that we may gain knowledge on how to monitor the quality of water at the health facilities” (KII Number 6a, QIFP).

Another key informant narrated that *“I wish we should discuss more on monitoring the quality of water at health facilities and emphasize more on facility Water, Sanitation and Hygiene (WASH) indicators to be monitored at the health facilities” (KII Number 7b, IPC FP).*

5. Discussion

5.1. Usefulness of the IPC ECHO Clinic to Users in 10 Referral Hospitals

IPC education is associated with decreased healthcare-associated infections and increased hand hygiene compliance [27]. Results of this study show that the IPC ECHO clinic was useful to healthcare workers as they gained knowledge in different IPC interventions, such as how to perform environmental surveillance, monitoring of SSIs, integrating IPC and AMS activities at the level of health facilities, as well as networking. Furthermore, online learning provided useful and effective access to up-to-date information on best practices in IPC [28]. This result is similar to other studies which have shown that online training provides an opportunity to increase the number of staff who are knowledgeable and competent in IPC, as well as improve IPC interventions at the health facilities [29] [30]. Other studies also highlighted that ECHO sessions were useful to healthcare workers in the areas of how to wear PPE, how to wash hands, and how to protect healthcare workers against diseases [31]. Additionally, our results are comparable to the study conducted in Idaho on stakeholder perceptions of the use of a rapidly deployed modified ECHO to train and prepare healthcare providers for COVID-19, where the ECHO clinic was useful to the participants in increasing their knowledge on different IPC issues such as transmission of diseases, best practices, PPE utilization, and sanitation during COVID-19 [32].

Study participants have recognized the knowledge they received on integrating and coordinating IPC and AMS interventions in combating the burden of AMR. Links and communication mechanisms of IPC interventions and other related services, including pharmacy, are key to identifying and characterizing etiological

agents for infections, facilitating detection of outbreaks, and identification of pathogens concerned for AMR [27]. A study conducted in Paraguay has also demonstrated that IPC and AMS teams benefited from online training on the areas of strengthening IPC and AMS programs in a coordinated and integrated manner [33].

In this study, networking was highlighted as one of the usefulness of the IPC ECHO clinic, whereby healthcare workers had the opportunity to be connected, collaborate, and share experiences among themselves at the health facilities, between health facilities, as well as network with IPC subject matter experts and facilitators at the national level. This result is similar to the study conducted in nine countries on the use of Project ECHO in response to COVID-19, wherein information sharing between geographically distant frontline providers and health system leaders was stated to be among the public health benefits of using Project ECHO, in which among sessions conducted was IPC [34]. Furthermore, the findings observed in this study are parallel to those observed in the study of the effects of the ECHO tele-mentoring program on human immunodeficiency virus/tuberculosis (HIV/TB) service delivery in health facilities in Zambia, whereby it was narrated that ECHO sessions linked providers with experts and also enabled healthcare workers to network within and across districts and provinces [35].

5.2. Topics/Areas Needed to Be Included in the Upcoming Curriculum for IPC ECHO Clinic

In our study healthcare workers suggested topics that need to be included in the upcoming curriculum for the IPC ECHO Clinic. These areas include: surveillance of HCAs; antimicrobial resistance; decontamination; waste management; IPC data analysis and use; hand hygiene; logistics for IPC supplies and equipment; guidance on the use of PPE at the health facilities; prevention of HCAs at dialysis units, and patients with heart and cancer diseases; and how to monitor the quality of water. These findings have been supported by other studies, including a study on IPC training conducted in six LMICs in which the topics recommended for IPC training included hand hygiene, donning and doffing of PPE, preventing needle stick injuries, reprocessing of reusable medical equipment, cleaning and disinfection, and waste management [25].

In the present study, decontamination was suggested as an area that should be considered in the next training curriculum. Our findings are in line with a study conducted in China to assess the effectiveness of IPC training, where key components of decontamination, such as disinfection and sterilization, were highlighted as among the key areas that need to be strengthened during IPC training for healthcare workers [24].

Surveillance of HCAs is important, not only for reducing HCAs and the early detection of outbreaks, but also for raising awareness about the importance of HCAs and AMR; hence, WHO strongly recommends that facility-based HCAs surveillance should be performed to guide IPC interventions [27]. In this study,

healthcare workers suggested that surveillance of HCAs should be prioritized in the next IPC ECHO training curriculum. This finding is in line with other studies that have also stressed the need to conduct training on HCAs surveillance so as to maximize patient safety [36]. Other studies have also recommended that timely feedback of surveillance results is key to guide IPC intervention [37].

Among the responsibilities of IPC teams at the facilities is to plan, monitor, and evaluate IPC interventions, as well as disseminate the collected data [1] [27]. In the current study, healthcare workers pointed out the need to be trained on how to analyze IPC data collected during research, supervision, mentorship, audits, and monitoring, as well as use of data to improve quality of service based on operational evidence. A study conducted to evaluate barriers of audit and feedback programs on hand hygiene has also identified a knowledge gap on how to incorporate findings of effective audit and feedback into routine improvement programs such as hand hygiene [38]. Furthermore, the study emphasizes that credible performance data and use of collected data to provide feedback to healthcare workers is key to drive behavior change [38].

Our study results show that healthcare workers need to be capacitated in the area of monitoring the quality of water. The WHO has also emphasized the need for regular monitoring of the control measures and periodic confirmation of water quality [17]. Monitoring the quality of water throughout the entire supply system, *i.e.*, from source to end user, is key to ensuring that the quality of water meets national standards, as well as detecting any problems that may occur and trigger necessary corrective actions [39].

5.3. Practical Implications for Policy Makers

Results of the evaluation of the IPC Project ECHO clinic are very useful and timely, as the global health community and countries, especially LMICs (including Tanzania), are experiencing a changing financing landscape in health systems [40] [41]. The changing financing landscape, marked by significant cuts in foreign aid by donor countries, requires LMICs to use innovative approaches in the use of available resources to meet the intended results. Therefore, the Ministry of Health (MoH) and the President's Office – Regional Administration and Local Government (which is responsible for the implementation of policy interventions at the sub-national level) need to allocate funding to ensure the sustainability of the intervention. This includes committing key Project ECHO activities in the institutional and health facilities' annual budgets. Also, programme managers and/or coordinators of key policy interventions such as IPC, AMR, and WASH need to leverage resources to ensure the continuity of the IPC ECHO clinic in Tanzania. The recent training in water quality monitoring at the household level [42] can also be scaled up through Project ECHO in order to reach more people; and a package for water quality monitoring in health facilities needs to be developed and delivered through Project ECHO to cater to the needs raised by the participants. The launched (on 16th July, 2025) One Health Project ECHO sessions at

Muhimbili National Hospital [43] is an excellent example of multi-sectoral efforts to sustain capacity building of healthcare workers on various topics using a one health approach through the Project ECHO platform.

6. Study Limitation

Despite the evaluation demonstrating that healthcare workers benefited from the IPC Project ECHO clinic, the study did not assess either the healthcare workers' competencies in IPC practices after the training or the impact of the IPC ECHO clinic on patient outcomes. Also, there could be a potential selection bias, as the participants were those already engaged with the IPC Project ECHO clinic. Their engagement may have influenced the observed largely positive feedback. However, they were able to pinpoint areas for improvement, and largely they were honest in their feedback, which gave comfort of minimal bias.

7. Conclusion and Recommendations

IPC Project ECHO clinic was found to be useful to healthcare workers as it enabled them to gain knowledge and skills in the implementation of IPC interventions, integration of AMS and IPC activities, as well as fostering networking among healthcare workers, health facilities, IPC subject matter experts, and facilitators in a manner that improved interdisciplinary collaboration. More efforts are required to ensure that the clinic curriculum elevates the content by going deeper into the following topics: surveillance of HCAIs; AMR; decontamination; waste management; IPC data analysis and use; hand hygiene; logistics for IPC supplies and equipment; guidance on the use of PPE at health facilities; and how to monitor quality of water.

Acknowledgements

The authors acknowledge technical and financial support provided by the United States Agency for International Development (USAID) through the MTaPS Project during the implementation of the IPC ECHO Clinic, as well as the evaluation of the clinic. Furthermore, the authors acknowledge the Hospital Management Teams of the 10 referral hospitals for allowing healthcare workers to participate in this evaluation. We gratefully acknowledge healthcare workers for their participation and significant contribution during the evaluation of the IPC ECHO Clinic.

Contributors

R.R.N, S.S.S, E.S.E, J.C.H, C.J.G, E.S.K, R.P.B, Y.S.M, O.A.N, S.M.M, L.E.M, M.H.M and M.M.D designed the study; R.R.N and S.S.S worked on data collection, data analysis, and writing of the draft zero manuscript. E.S.K and L.E.M participated in writing the draft zero manuscript. D.L, E.S.E, J.C.H, C.J.G, R.P.B, Y.S.M, O.A.N, S.M.M, M.M.D, T.A.Y, J.L, D.P, and E.L revised the manuscript. E.S.E provided substantial support in management and technical aspects during

the development of the study and writing of the manuscript. The final manuscript was approved by all authors.

Conflicts of Interest

The authors affirm that they have no competing interests that could influence the work reported in this paper.

References

- [1] MoHCDGEC (2018) National Infection Prevention and Control Guidelines for Healthcare Services in Tanzania. <https://policyvault.africa/wp-content/uploads/policy/TZA263.pdf>
- [2] WHO (2022) Global Report on Infection Prevention and Control. <https://www.who.int/publications/i/item/9789240051164>
- [3] Puro, V., Coppola, N., Frasca, A., Gentile, I., Luzzaro, F., Peghetti, A., *et al.* (2022) Pillars for Prevention and Control of Healthcare-Associated Infections: An Italian Expert Opinion Statement. *Antimicrobial Resistance & Infection Control*, **11**, Article No. 87. <https://doi.org/10.1186/s13756-022-01125-8>
- [4] MoHCDGEC (2018) Standard Operating Procedures for Infection Prevention and Control for Ebola Virus Disease Cases. <https://policyvault.africa/policy/standard-operating-procedures-for-infection-prevention-and-control-for-ebola-virus-disease-cases>
- [5] MoHCDGEC (2020) Standard Operating Procedures (SOPs) for Case Management and Infection, Prevention and Control Case Management.
- [6] Kinyenje, E., Hokororo, J., Ngowi, R., Kiremeji, M., Mnunga, E., Samwel, A., *et al.* (2024) Infection Prevention and Control of Highly Infectious Pathogens in Resource-Limited Countries: An Experience from Marburg Viral Disease Outbreak in Kagera Region—Tanzania. *BMC Infectious Diseases*, **24**, Article No. 628. <https://doi.org/10.1186/s12879-024-09508-5>
- [7] Amberbir, A., Sayinzoga, F., Mathewos, K., Ntawukuriryayo, J.T., VanderZanden, A., Hirschhorn, L.R., *et al.* (2024) Maintaining Delivery of Evidence-Based Interventions to Reduce Under-5 Mortality during COVID-19 in Rwanda: Lessons Learned through Implementation Research. *Annals of Global Health*, **90**, Article 47. <https://doi.org/10.5334/aogh.4348>
- [8] Amberbir, A., Huda, F.A., VanderZanden, A., Mathewos, K., Ntawukuriryayo, J.T., Binagwaho, A., *et al.* (2024) Mitigating the Impact of COVID-19 on Primary Healthcare Interventions for the Reduction of Under-5 Mortality in Bangladesh: Lessons Learned through Implementation Research. *PLOS Global Public Health*, **4**, e0002997. <https://doi.org/10.1371/journal.pgph.0002997>
- [9] Jones, T., Marimuthu, K. and Bearman, G. (2022) Virtual Infection Prevention and Control in Low- and Middle-Income Countries. *International Journal of Infectious Diseases*, **117**, 93-96. <https://doi.org/10.1016/j.ijid.2022.01.065>
- [10] Mohamed, Y., Hezeri, P., Kama, H., Mills, K., Walker, S., Hau’ofa, N., *et al.* (2023) Evaluation of an Online Training Program on COVID-19 for Health Workers in Papua New Guinea. *Tropical Medicine and Infectious Disease*, **8**, Article 327. <https://doi.org/10.3390/tropicalmed8060327>
- [11] Hamisi, N.M., Dai, B. and Ibrahim, M. (2023) Global Health Security Amid COVID-19: Tanzanian Government’s Response to the COVID-19 Pandemic. *BMC Public Health*, **23**, Article No. 205. <https://doi.org/10.1186/s12889-023-14991-7>

- [12] Ngowi, R.R., Simba, S.S., Eliakimu, E.S., Hokororo, J.C., Lutkam, D., Kinyenje, E.S., *et al.* (2024) Evaluation of Infection Prevention and Control Extension for Community Healthcare Outcome Clinic in Referral Hospitals in Tanzania. *Journal of Service Science and Management*, **17**, 248-268. <https://doi.org/10.4236/jssm.2024.173012>
- [13] WHO (2019) Minimum Requirements for Infection Prevention and Control Programmes. <https://www.who.int/publications/i/item/9789241516945>
- [14] Buyego, P., Katwesigye, E., Kebirungi, G., Nsubuga, M., Nakyejwe, S., Cruz, P., *et al.* (2022) Feasibility of Virtual Reality Based Training for Optimising COVID-19 Case Handling in Uganda. *BMC Medical Education*, **22**, Article No. 274. <https://doi.org/10.1186/s12909-022-03294-x>
- [15] Zhang, M., Wu, S., Ibrahim, M.I., Noor, S.S.M. and Mohammad, W.M.Z.W. (2024) Significance of Ongoing Training and Professional Development in Optimizing Healthcare-Associated Infection Prevention and Control. *Journal of Medical Signals & Sensors*, **14**, 13. https://doi.org/10.4103/jmss.jmss_37_23
- [16] Mothibi, K. (2021) Infection Prevention and Control Knowledge and Practices among Healthcare Workers in Lobatse District Health Management Team (LDHMT) Facilities: A Call for an Educational Intervention. Master's Thesis, Georgia State University.
- [17] WHO (2015) Water, Sanitation and Hygiene in Health Care Facilities Status in Low and Middle-Income Countries and Way Forward. https://iris.who.int/bitstream/handle/10665/154588/9789241508476_eng.pdf
- [18] MTaPS (2023) Program Advancing Tanzania's Infection Prevention and Control Capacity through e-Learning. <https://www.mtapsprogram.org/news-blog/advancing-tanzanias-infection-prevention-and-control-capacity-through-e-learning>
- [19] Kobayashi, D., Mami, K., Fujishiro, S., Nukanobu, N., Ueno, S., Kuwakado, S., *et al.* (2023) Online Training of Covid-19 Infection Prevention and Control for Healthcare Workers in Psychiatric Institutes. *BMC Psychiatry*, **23**, Article No. 325. <https://doi.org/10.1186/s12888-023-04826-5>
- [20] Burton, S., Landers, T., Wilson, M., Ortiz-Gumina, C., Persaud, A., McNeill Ransom, M., *et al.* (2023) Public Health Infection Prevention: An Analysis of Existing Training during the COVID-19 Pandemic. *Public Health*, **222**, 7-12. <https://doi.org/10.1016/j.puhe.2023.06.029>
- [21] Wilson, K., Dennison, C., Struminger, B., Armistad, A., Osuka, H., Montoya, E., *et al.* (2021) Building a Virtual Global Knowledge Network during the Coronavirus Disease 2019 Pandemic: The Infection Prevention and Control Global Webinar Series. *Clinical Infectious Diseases*, **73**, S98-S105. <https://doi.org/10.1093/cid/ciab320>
- [22] UNICEF (2020) Webinar Infection Prevention and Control (IPC) Global Webinar Series. <https://agora.unicef.org/course/info.php?id=28069>
- [23] Thomas, M.P., Kozikott, S., Kamateeka, M., Abdu-Aguye, R., Agogo, E., Bello, B.G., *et al.* (2022) Development of a Simple and Effective Online Training for Health Workers: Results from a Pilot in Nigeria. *BMC Public Health*, **22**, Article No. 551. <https://doi.org/10.1186/s12889-022-12943-1>
- [24] Han, B., Zang, F., Liu, J., Li, S., Zhang, W., Zhang, Y., *et al.* (2022) Effect Analysis of "Four-Step" Training and Assessment Tool in the Prevention and Control of Covid-19. *Infection and Drug Resistance*, **15**, 1247-1257. <https://doi.org/10.2147/idr.s346559>
- [25] Qureshi, M., Chughtai, A. and Seale, H. (2022) Supporting the Delivery of Infection Prevention and Control Training to Healthcare Workers: Insights from the Sector.

- Healthcare*, **10**, Article 936. <https://doi.org/10.3390/healthcare10050936>
- [26] Elo, S., Kääriäinen, M., Kanste, O., Pölkki, T., Utriainen, K. and Kyngäs, H. (2014) Qualitative Content Analysis: A Focus on Trustworthiness. *Sage Open*, **4**, 1-10. <https://doi.org/10.1177/2158244014522633>
- [27] WHO (2016) Guidelines on Core Components of Infection Prevention and Control Programmes at the National and Acute Health Care Facility Level. World Health Organization. <https://iris.who.int/bitstream/handle/10665/251730/9789241549929-eng.pdf?sequence=1>
- [28] Atack, L. and Luke, R. (2008) Impact of an Online Course on Infection Control and Prevention Competencies. *Journal of Advanced Nursing*, **63**, 175-180. <https://doi.org/10.1111/j.1365-2648.2008.04660.x>
- [29] Penna, A.R., Hunter, J.C., Sanchez, G.V., Mohelsky, R., Barnes, L.E.A., Benowitz, I., *et al.* (2022) Evaluation of a Virtual Training to Enhance Public Health Capacity for COVID-19 Infection Prevention and Control in Nursing Homes. *Journal of Public Health Management & Practice*, **28**, 682-692. <https://doi.org/10.1097/phh.0000000000001600>
- [30] Kessy, S.J., Gon, G., Alimi, Y., Bakare, W.A., Gallagher, K., Hornsey, E., *et al.* (2023) Training a Continent: A Process Evaluation of Virtual Training on Infection Prevention and Control in Africa during Covid-19. *Global Health: Science and Practice*, **11**, e2200051. <https://doi.org/10.9745/ghsp-d-22-00051>
- [31] Panda, R., Mishra, N., Lahoti, S., Prabhu, R.R., Mishra, A., Singh, K., *et al.* (2022) Evaluation of COVID-19 ECHO Training Program for Healthcare Workers in India—A Mixed-Method Study. *BMC Health Services Research*, **22**, Article No. 883. <https://doi.org/10.1186/s12913-022-08288-5>
- [32] Casanova, M.P., Blades, K.C., Palmer, K., Smith, L.H., Fuerst, P., Seegmiller, J.G., *et al.* (2022) Stakeholder Perceptions of the Use of a Rapidly Deployed Modified ECHO to Train and Prepare Healthcare Providers for Covid-19. *Journal of Public Health Research*, **11**, 1-8. <https://doi.org/10.1177/22799036221123992>
- [33] WHO (2024) Multimodal Intervention to Promote Antimicrobial Stewardship and Reduce Device-Associated Infections in Intensive Care Units of Hospitals in Paraguay, 2021-2023. <https://www.who.int/news-room/articles-detail/multimodal-intervention-to-promote-antimicrobial-stewardship-in-paraguay>
- [34] Wright, J., Tison, L., Chun, H., Gutierrez, C., Ning, M.F., Morales, R.E., *et al.* (2022) Use of Project ECHO in Response to COVID-19 in Countries Supported by US President's Emergency Plan for AIDS Relief. *Emerging Infectious Diseases*, **28**, S191-S196. <https://doi.org/10.3201/eid2813.220165>
- [35] Mubanga, B., Fwoloshi, S., Lwatula, L., Siamwanza, N., Zyambo, K., Sichinga, H., *et al.* (2023) Effects of the ECHO Tele-Mentoring Program on HIV/TB Service Delivery in Health Facilities in Zambia: A Mixed-Methods, Retrospective Program Evaluation. *Human Resources for Health*, **21**, Article No. 24. <https://doi.org/10.1186/s12960-023-00806-8>
- [36] Shenoy, E.S. and Branch-Elliman, W. (2023) Automating Surveillance for Healthcare-Associated Infections: Rationale and Current Realities (Part I/III). *Antimicrobial Stewardship & Healthcare Epidemiology*, **3**, e23. <https://doi.org/10.1017/ash.2022.312>
- [37] Storr, J., Twyman, A., Zingg, W., Damani, N., Kilpatrick, C., Reilly, J., *et al.* (2017) Core Components for Effective Infection Prevention and Control Programmes: New

- WHO Evidence-Based Recommendations. *Antimicrobial Resistance & Infection Control*, **6**, Article No. 6. <https://doi.org/10.1186/s13756-016-0149-9>
- [38] Livorsi, D.J., Goedken, C.C., Sauder, M., Vander Weg, M.W., Perencevich, E.N. and Reisinger, H.S. (2018) Evaluation of Barriers to Audit-And-Feedback Programs That Used Direct Observation of Hand Hygiene Compliance. *JAMA Network Open*, **1**, e183344. <https://doi.org/10.1001/jamanetworkopen.2018.3344>
- [39] Ministry of Water and Irrigation (MoWI) (2018) National Guideline on Drinking Water Quality Monitoring and Reporting. <https://www.maji.go.tz/uploads/publications/sw1541500878-National%20Guide-line%20on%20Drinking%20Water%20Quality%20Monitoring%20and%20Reporting.pdf>
- [40] Africa Centres for Disease Control and Prevention (AfricaCDC) (2025) Africa's Health Financing in a New Era. <https://africacdc.org/news-item/africas-health-financing-in-a-new-era-april-2025>
- [41] Rasanathan, K., Beltran, M.M., Biritwum-Nyarko, A.A., Blecher, M.S., Dybul, M., Inoue, H., *et al.* (2025) Navigating Health Financing Cliffs: A New Era in Global Health. *The Lancet*, **405**, 1893-1895. [https://doi.org/10.1016/s0140-6736\(25\)00720-2](https://doi.org/10.1016/s0140-6736(25)00720-2)
- [42] MoH (2025) Wekeni Mikakati ya Pamoja kwa Watanzania Kutumia Maji Safi na Salama. Dodoma. <https://www.moh.go.tz/news-single/wekeni-mikakati-ya-pamoja-kwa-watanzania-kutumia-maji-safi-na-salama>
- [43] Daily News (2025) Tanzania Inaugurates Online Programme on One Health. <https://dailynews.co.tz/tanzania-inaugurates-online-programme-on-one-health/>